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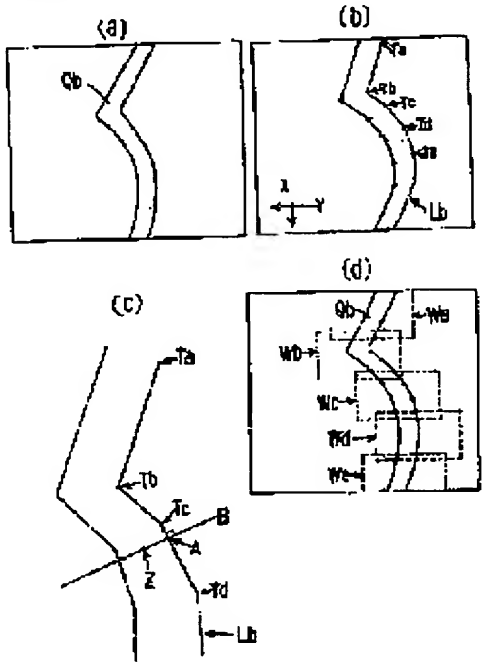
(54) METHOD FOR DETECTING APPLIED STATE OF SEALANT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method for detecting applied state of sealant, by which the applied amount of a sealant can be judged from the length and cross-sectional area of the applied sealant, by estimating the cross-sectional area and the shape variation of the sealant can be measured precisely by easily setting windows correspondingly to the shape variation.
SOLUTION: The method for detecting applied state of sealant includes a step of picking up the image of a prescribed area of a sealant linearly applied to a surface to be applied from right above, a step of temporarily polygonally approximating the border lines of the sealant on both sides in the image Qb picked up in the preceding step, a step of equally dividing the sealant in the picture Qb into a plurality of sealant parts based on the coordinates Ta, Tb,... of the edges of the polygonal lines, a step of setting the center coordinates of a plurality of windows Wa, Wb,... in which the divided sealant parts are respectively positioned at their centers from the coordinates Ta, Tb,..., and a step of canceling the polygonal lines and, at the same time, detecting the applied states of the sealant parts, such as the widths, positions, etc., in the windows Wa, Wb,... set at the center coordinates.



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CLAIMS

[Claim(s)]

[Claim 1] The application state method of detection of a sealing compound characterized by providing the following. The process which picturizes the predetermined field of the sealing compound applied to the coated side at the line from right above. The process which carries out broken line approximation of the both-sides border line of the sealing compound of the picture acquired by the aforementioned image pck-up temporarily. The process which divides the sealing compound within a picture equally into two or more sealing-compound portions based on the coordinate of each edge of the aforementioned broken line within the aforementioned picture. The process which detects application states, such as width of face of the sealing-compound portion in each window set up with the aforementioned main coordinate, and a position, while canceling the process which sets up the main coordinate of two or more windows which locate each aforementioned sealing-compound portion in the center of a window, respectively, and the aforementioned broken line approximation of the coordinate of each edge of each aforementioned sealing-compound portion.

[Claim 2] To the sealing compound of the predetermined field applied to the coated side at the line by irradiating lighting light from the right-and-left both-sides slanting upper part toward the longitudinal direction of the aforementioned sealing compound at a bilateral symmetry Shading corresponding to the cross-section configuration of the aforementioned sealing compound is formed on the aforementioned coated side of the both sides of the aforementioned sealing compound. Binary-ization-process the aforementioned shading, form the pattern picture of a bright section and dark space, and it asks for the correspondence relation between the characteristic quantity on the aforementioned pattern picture, and the cross section of a sealing compound. The application state method of detection of the sealing compound according to claim 1 characterized by measuring the characteristic quantity of the measured pattern picture and calculating the cross section of the sealing compound of a predetermined field by the above-mentioned correspondence relation.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the method of detecting the quality of the application state of the sealing compound applied to mating faces, such as an oil pan mechanism of transmission, at the line.

[0002]

[Description of the Prior Art] About an oil pan mechanism, extension housing, etc. of transmission, it attaches, and it attaches in one and there are mating faces and a process to seal among the production process of an automobile. In that case, as shown in drawing 4 (a) and (d) letter crevice of ups and downs (1c) {which covered the marginal part perimeter of the mating face (1a) (2a) of an oil pan mechanism (1) and extension housing (2), avoided screwhole (1b) --(2b)-- etc., and was formed -- drawing 4 (b) -- reference} -- a sealing-compound {liquefied gasket () [Formed] In the mating faces (1a) (2a) after applying Place Gasket} (3) -- screw stop fixation is attached and carried out It is attached a mating face (1a) (2a) crashing a sealing compound (3) by screw stop fixation, and filling a crevice (1c), if it does so, and seals without a crevice. In addition, the b-b line cross section of drawing 4 (a), the c section detail drawing, and drawing 4 (e) of drawing 4 (b) and (c) are the e section detail drawing of drawing 4 (d).

[0003] When there are too many coverages of a sealing compound (3) at this time, when an excessive sealing compound (3) falls to an oil pan mechanism (1) and mixes in oil, oilway plugging is produced, since the portion into which the sealing compound (3) went out when too few on the contrary to this oil spillage is produced, it is necessary to detect an application state and an example of the detection means is shown below with reference to drawing 5 and drawing 6 . As for an image pck-up means of fixation, such as a CCD camera, by which (4) picturizes a work (5) from right above, the image processing system by which (6) was connected to the image pck-up means (4), and (7), in drawing 5 , a lighting system and (8) are picture monitors.

[0004] If the sealing-compound picture (Qa) which picturizes the sealing compound (3) applied to the oil pan mechanism etc., and is shown in drawing 6 (a) is acquired according to the above-mentioned composition, as shown in drawing 6 (b), the edge of a sealing compound (3) will be detected from the lightness difference (Ha) of the light-and-darkness section of the sealing-compound picture (Qa) in an inspection line (La). And a perimeter is covered, application width of face (Da), an application position, an application piece, etc. are detected, and a multiple-regression formula detects the quality of an application state. If all the pictures that the sealing-compound picture (Qa) picturized are collectively measured at

this time, the partial fine state of the sealing compound (3) reflected in one screen, a size, etc. are immeasurable. Then, if a sealing compound (3) is greatly picturized in order to measure finely, since the number of sheets of an image pck-up picture will increase, the processing time becomes long.

[0005] Then, it is finely measurable, if the window set up beforehand is put on a sealing-compound picture (Qa), an image pck-up picture is divided and the picture in a window is measured.

[0006]

[Problem(s) to be Solved by the Invention] According to the above-mentioned detection means, since the application state is detected from the superficial image pck-up picture of a sealing compound (3), there is fault that it cannot detect to a three-dimensional cross-section thickness configuration, and the quality of a coverage cannot be detected. Moreover, when putting the set-up window on a sealing-compound picture (Qa) and measuring it finely, since the sealing compound (3) has bent, a setup of a window cannot respond to configuration change of the deflection of a sealing compound (3) etc., and the detection corresponding point of a sealing-compound picture (Qa) may be settled in a window, and may not go out.

[0007] The purpose of this invention is offering the application state method of detection of the sealing compound which presumes the cross section of the applied sealing compound, and can judge a coverage with length and the cross section, and sets up a window easily corresponding to configuration change of a sealing compound, and can be measured finely.

[0008]

[Means for Solving the Problem] The process which picturizes the predetermined field of a sealing compound where this invention was applied to the coated side at the line from right above, The process which carries out broken line approximation of the both-sides border line of the sealing compound of the picture acquired by the aforementioned image pck-up temporarily, The process which divides the sealing compound within a picture equally into two or more sealing-compound portions based on the coordinate of each edge of the aforementioned broken line within the aforementioned picture, While canceling the process which sets up the main coordinate of two or more windows which locate each aforementioned sealing-compound portion in the center of a window, respectively, and the aforementioned broken line approximation of the coordinate of each edge of each aforementioned sealing-compound portion As opposed to the sealing compound of the predetermined field which was characterized by having the process which detects application states, such as width of face of the sealing-compound portion in each window set up with the aforementioned main coordinate, and a position, and was applied to the coated side at the line By irradiating lighting light from the right-and-left both-sides slanting upper part toward the longitudinal direction of the aforementioned sealing compound at a bilateral symmetry Shading corresponding to the cross-section configuration of the

aforementioned sealing compound is formed on the aforementioned coated side of the both sides of the aforementioned sealing compound. Binary--ization-process the aforementioned shading, form the pattern picture of a bright section and dark space, and it asks for the correspondence relation between the characteristic quantity on the aforementioned pattern picture, and the cross section of a sealing compound. It is characterized by measuring the characteristic quantity of the measured pattern picture and calculating the cross section of the sealing compound of a predetermined field by the above-mentioned correspondence relation.

[0009]

[Embodiments of the Invention] The gestalt of operation of the application state method of detection of the sealing compound concerning this invention is explained below with reference to drawing 1 - drawing 3 . First, drawing 1 shows the equipment for enforcing this invention method, and (10) includes a downward CCD camera and downward lighting in drawing. The image pck-up unit which picturizes the sealing compound (3) which was attached in the rectangular robot for movement (11), and was applied to the work (12), for example, an oil pan mechanism, from right above, The image processing system by which (13) was connected to the image pck-up unit (10), the personal computer by which (14) and (15) were connected to the image processing system (13) and a picture monitor, and (16) are the power supplies for lighting connected to the image pck-up unit (10) and the personal computer (14).

[0010] Based on the above-mentioned composition, operation (method) of this invention is explained below. First, as shown in drawing 2 (a), lighting light is irradiated from the right-and-left both-sides slanting upper part toward the longitudinal direction of a sealing compound (3) at a bilateral symmetry at the linear sealing compound (3) applied to the oil pan mechanism by the in-a-circle lighting (Ua) of an image pck-up unit (10), and (Ub), and a sealing compound (3) is picturized from right above by the CCD camera (calcium) of an image pck-up unit (10). If it does so, shading corresponding to the cross-section thickness configuration of a sealing compound (3) will be formed on a coated side, and as shown in drawing 2 (b) - (f), pattern picture [of the bright section of a predetermined configuration and dark space] (Pb) - (Pf) will arise by shading. The pattern picture (Pb) - (Pf) changes according to a sealing compound (3b) - (3f) a flat surface (width of face), and a cross-section (thickness) configuration, and becomes a thing reflecting the cross-section configuration. In addition, a pattern picture (Pb), (Pc), (Pd) and (Pe), and (Pf) are based on lighting (Ua) and (Ub), respectively.

[0011] Next, if the sealing-compound picture (Qb) shown in drawing 3 (a) by making the outermost edge (Mb) of the right-and-left dark space of - (Pf), pattern picture (Pb) (Nb) - (Mf), and (Nf) into a profile is acquired, as shown in drawing 3 (b), the profile (Mb) of drawing 2 , (Nb) - (Mf), and (Nf) will be temporarily approximation-ized on a broken line (Lb). And the main coordinate of reference} is set up for the broken line (two or more

window (Wa) -(We) { drawing 3 (c which the sealing compound within a picture (Qb) is equally divided [c] into two or more sealing-compound portions based on the coordinate of each edge of Lb), and locates each above-mentioned sealing-compound portion in the center of a window from the coordinate of each above-mentioned edge, respectively) within a picture (Qb).

[0012] For example, each edge coordinate (Ta) of the profile of the longer one and (Tb) -- are measured, and the distance between edges is measured along with a profile. And supposing the mid-position (A) between (Tb) - (Td) is between (Tc) - (Td) exceeding the set point between (Tb) - (Td) when the measured distance between edges exceeds the set point for example Window (Wa) - (We) is set up for the point (Z) that the perpendicular (B) of straight-line (Tc) - (Td) passing through the mid-position (A) crosses the center of the cross direction of a sealing compound, as a center of a window. In addition, the center of the cross direction of a sealing compound is the mid-position of the cross direction between the outermost edge (Mb) of the right-and-left dark space of - (Pf), - between pattern picture (Pb) (Nb(s)) by the above-mentioned shading (Mf), and (Nf).

[0013] And as shown in drawing 3 (c), a sealing-compound picture (Qb) is covered, making an adjoining edge lengthwise [the] (X) two or more window (Wa) - (We) overlap for every main coordinate. If it does so, a sealing-compound picture (Qb) will be altogether settled in window (Wa) - (We), and, moreover, the length of the sealing-compound portion in each window will become abbreviation homogeneity.

[0014] Then, as shown in drawing 2 (b) - (f), pattern picture (Pb) - (Pf) is binary--ization-processed, and the position of a bright section or dark space, area, and a number are measured at once for every window from the binary-ized picture of pattern picture (Pb) - (Pf). The measurement data changes according to the width of face and the cross-section configuration of a sealing compound (3) as mentioned above, and reflects a cross-section configuration. For example, at the time of irradiation of lighting (Ua), as shown in drawing 2 (b), when a sealing-compound (3b) cross section is circular, a sealing-compound crowning becomes the brightest, and the contiguity section becomes dark and acquires a pattern picture (Pb). moreover, the case where a sealing-compound (3c) cross section is an oblong ellipse as shown in drawing 2 (c) -- the bright section of a sealing-compound crowning -- the time of cross-section circular -- broad -- becoming -- a pattern picture (Pc) -- obtaining -- further -- a cross section -- a bright section becomes broad, so that it becomes flat Moreover, as shown in drawing 2 (d), when a sealing-compound (3d) upper surface center section is dented a little and two crownings arise, two bright sections arise and a pattern picture (Pd) is acquired. Similarly, according to a round shape and each sealing-compound (3e) (3f) cross section of a semicircle, a pattern picture (Pe) and (Pf) are obtained, respectively at the time of irradiation of lighting (Ub). Therefore, the sealing-compound cross section can be presumed from pattern picture (Pa) - (Pf).

[0015] The coverage (volume) of a sealing compound (3) can be computed by on the other

hand multiplying the length which met the profile of pattern picture (Pb) · in a window (Pf) by the above-mentioned cross section.

[0016] Then, it asks for the correspondence relation between the characteristic quantity on the picture of the pattern picture of the light and darkness which appear according to the sealing-compound cross section beforehand (for example, the width of face of a bright section, area and the width of face of dark space, and area), and the cross section of a sealing compound. For example, it asks for the multiple-regression formula which makes the purpose variable the cross section of an explanation variable and a sealing compound for the above-mentioned characteristic quantity beforehand. And the characteristic quantity for every window of the measured light-and-darkness pattern picture is measured, and the cross section of a sealing compound is calculated from the above-mentioned multiple-regression formula. Furthermore, a coverage (volume) is computed by multiplying this cross section by the length of the sealing compound on a picture.

[0017] Or the cross section, the length, and the amount according to the light-and-darkness pattern are created as standard data, matching contrast of the pattern picture and standard-pattern picture of light and darkness which were measured is carried out, a sealing-compound flat surface (length) and a cross-section configuration (cross section) are presumed for every window, and a sealing-compound coverage is detected. Although the flat surface and cross-section configuration of a sealing compound which were applied are various at this time, it is substantially restricted to a certain limited number of kinds, and since the kind of appearing configuration is restricted, the number of standard data which should be prepared also falls within a certain range. What is necessary is just to resemble the nearest standard data, supposing there are no standard data which are correctly in agreement in the measured light-and-darkness pattern picture.

[0018] In addition, in the determination of this nearest standard data, fuzzy reasoning is applicable.

[0019]

[Effect of the Invention] In detecting the application state of the sealing compound applied on coated sides, such as a mating face of an oil pan mechanism, according to this invention Shading which irradiated lighting light from the slanting upper part at the bilateral symmetry, and reflected the cross-section configuration in the sealing compound is formed on a coated side. And picturize a sealing compound from right above and the border line of a sealing-compound picture is temporarily formed into broken line approximation. Based on the coordinate of the edge of the above-mentioned broken line, a sealing compound is equally divided into two or more sealing-compound portions. The main coordinate of two or more windows which locate a sealing-compound portion in the center of a window from the coordinate of the above-mentioned edge is set up. Binary-ization-process shading of a predetermined configuration which changes according to the flat surface and cross-section configuration of a sealing compound for every window, and the pattern picture of a bright

section and dark space is formed. It asks for the correspondence relation between the characteristic quantity of the above-mentioned pattern picture, and the cross section of a sealing compound. Since the characteristic quantity for every window of the measured pattern picture was measured and the cross section of a sealing compound was calculated by the above-mentioned correspondence relation, the sealing-compound cross section can be presumed, a coverage can be detected by the length of a sealing compound, and generating of oilway plugging etc. can be prevented. Moreover, when measuring finely, a sealing compound can set up a window easily according to a sealing-compound configuration in any configurations, and the processing time is shortened.

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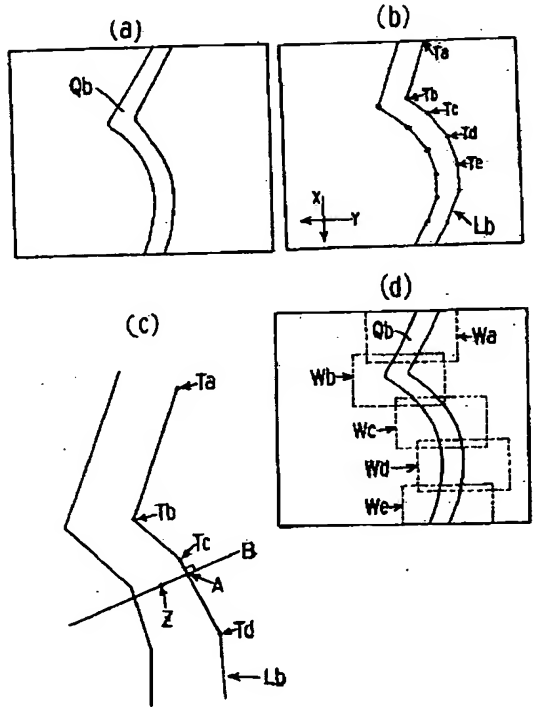
(54)【発明の名称】シール剤の塗布状態検出方法

(57)【要約】
【課題】シール剤の平面的撮像画像から塗布形状を検出しているため、断面厚み形状まで検出出来ず、塗布量の良否を検出出来ない。又、細かく計測する場合、ウィンドウの設定がシール剤の曲がり等の形状変化に容易に対応出来ない。
【解決手段】被塗布面に線状に塗布されたシール剤の所定領域を真上から撮像する工程と、前記撮像で得られた画像Ｑｂのシール剤の両側輪郭線を一時的に折線近似する工程と、前記画像Ｑｂ内における前記折線の各エッジの座標Ｔａ、Ｔｂ…に基づいて、画像Ｑｂ内のシール剤を複数のシール剤部分に等分する工程と、前記各シール剤部分の各エッジの座標Ｔａ、Ｔｂ…から前記各シール剤部分をそれぞれウィンドウ中央に位置させる複数のウィンドウＷａ、Ｗｂ…の中心座標を設定する工程と、前記折線近似を解除すると共に、前記中心座標で設定した各ウィンドウＷａ、Ｗｂ…内のシール剤部分の幅や位置などの塗布状態を検出する工程とを有する。



【特許請求の範囲】

【請求項１】被塗布面に線状に塗布されたシール剤の所定領域を真上から撮像する工程と、前記撮像で得られた画像のシール剤の両側輪郭線を一時的に折線近似する工程と、前記画像内における前記折線の各エッジの座標に基づいて、画像内のシール剤を複数のシール剤部分に等分する工程と、前記各シール剤部分の各エッジの座標から前記各シール剤部分をそれぞれウィンドウ中央に位置させる複数のウィンドウの中心座標を設定する工程と、前記折線近似を解除すると共に、前記中心座標で設定した各ウィンドウ内のシール剤部分の幅や位置などの塗布状態を検出する工程とを有することを特徴とするシール剤の塗布状態検出方法。

【請求項２】被塗布面に線状に塗布された所定領域のシール剤に対して、前記シール剤の長手方向に向かって左右両側斜め上方から左右対称に照明光を照射することにより、前記シール剤の断面形状に対応した陰影を前記シール剤の両側の前記被塗布面上に形成し、前記陰影を２値化処理して明部と暗部のパターン画像を形成し、前記パターン画像上の特徴量とシール剤の断面積との対応関係を求め、計測されたパターン画像の特徴量を測定して上記対応関係により所定領域のシール剤の断面積を演算するようにしたことを特徴とする請求項１記載のシール剤の塗布状態検出方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、トランスミッションのオイルパン等の合わせ面に線状に塗布されたシール剤の塗布状態の良否を検出する方法に関するものである。

【０００２】

【従来の技術】自動車の生産工程中、トランスミッションのオイルパンやエクステンションハウジング等を合わせ面同士、衝合して一体的に組み付けて封着する工程がある。その際、図４（ａ）（ｄ）に示すように、オイルパン（１）やエクステンションハウジング（２）の合わせ面（１ａ）（２ａ）の縁部全周に亘りネジ孔（１ｂ）…（２ｂ）…等をよけて形成された曲折状凹部（１ｃ）｛図４（ｂ）を参照｝にシール剤｛液状ガスケット（Formed In Place Gasket）｝（３）を塗布した後、合わせ面（１ａ）（２ａ）同士、衝合してネジ止め固定する。そうすると、合わせ面（１ａ）（２ａ）がネジ止め固定によりシール剤（３）を圧潰して凹部（１ｃ）を埋めつつ衝合され、隙間なく封着される。尚、図４（ｂ）（ｃ）は図４（ａ）のｂ－ｂ線断面図とｃ部詳細図、図４（ｅ）は図４（ｄ）のｅ部詳細図である。

【０００３】この時、シール剤（３）の塗布量が多すぎると、余分なシール剤（３）がオイルパン（１）に落ちてオイルに混入することにより油路詰まりを生じ、この反対に少なすぎると、シール剤（３）の切れた部分から油漏れを生じるため、塗布状態を検出する必要があり、その検出手段の一例を図５及び図６を参照して次に示す。図５において（４）はワーク（５）を真上から撮像するＣＣＤカメラ等の固定の撮像手段、（６）は撮像手段（４）に接続された画像処理装置、（７）は照明装置、（８）は画像モニターである。

【０００４】上記構成によれば、オイルパン等に塗布したシール剤（３）を撮像して図６（ａ）に示すシール剤画像（Ｑａ）を得ると、図６（ｂ）に示すように、検査ライン（Ｌａ）におけるシール剤画像（Ｑａ）の明暗部の明度差（Ｈａ）からシール剤（３）のエッジを検出する。そして、塗布幅（Ｄａ）、塗布位置、塗布切れ等を全周に亘って検出して重回帰式により塗布状態の良否を検出する。この時、シール剤画像（Ｑａ）の撮像した画像の全てを一括して計測すると、一画面に映っているシール剤（３）の部分的な細かい状態、太さ等は計測出来ない。そこで、細かく計測するためにシール剤（３）を大きく撮像すると、撮像画像の枚数が多くなるため、処理時間が長くなる。

【０００５】そこで、予め設定されたウィンドウをシール剤画像（Ｑａ）に被せて撮像画像を分割し、ウィンドウ内の画像を計測すれば、細かく計測出来る。

【０００６】

【発明が解決しようとする課題】上述の検出手段によれば、シール剤（３）の平面的撮像画像から塗布状態を検出しているため、立体的な断面厚み形状まで検出出来ず、塗布量の良否を検出出来ないという不具合がある。又、設定されたウィンドウをシール剤画像（Ｑａ）に被せて細かく計測する場合、シール剤（３）は曲がっているため、ウィンドウの設定がシール剤（３）の曲がり等の形状変化に対応出来ず、シール剤画像（Ｑａ）の検出対応部分がウィンドウ内に収まり切れないことがある。

【０００７】本発明の目的は、塗布されたシール剤の断面積を推定し、長さと断面積とで塗布量を判定出来、且つ、シール剤の形状変化に対応してウィンドウを容易に設定して細かく計測出来るシール剤の塗布状態検出方法を提供することである。

【０００８】

【課題を解決するための手段】本発明は、被塗布面に線状に塗布されたシール剤の所定領域を真上から撮像する工程と、前記撮像で得られた画像のシール剤の両側輪郭線を一時的に折線近似する工程と、前記画像内における前記折線の各エッジの座標に基づいて、画像内のシール剤を複数のシール剤部分に等分する工程と、前記各シール剤部分の各エッジの座標から前記各シール剤部分をそれぞれウィンドウ中央に位置させる複数のウィンドウの中心座標を設定する工程と、前記折線近似を解除すると共に、前記中心座標で設定した各ウィンドウ内のシール剤部分の幅や位置などの塗布状態を検出する工程とを有することを特徴とし、又、被塗布面に線状に塗布された

所定領域のシール剤に対して、前記シール剤の長手方向に向かって左右両側斜め上方から左右対称に照明光を照射することにより、前記シール剤の断面形状に対応した陰影を前記シール剤の両側の前記被塗布面上に形成し、前記陰影を２値化処理して明部と暗部のパターン画像を形成し、前記パターン画像上の特徴量とシール剤の断面積との対応関係を求め、計測されたパターン画像の特徴量を測定して上記対応関係により所定領域のシール剤の断面積を演算するようにしたことを特徴とする。

【０００９】

【発明の実施の形態】本発明に係るシール剤の塗布状態検出方法の実施の形態を図１～図３を参照して以下に説明する。まず図１は本発明方法を実施するための装置を示し、図において（１０）は下向きのＣＣＤカメラや照明を含み、移動用直交ロボット（１１）に取り付けられてワーク（１２）、例えばオイルパンに塗布されたシール剤（３）を真上から撮像する撮像ユニット、（１３）は撮像ユニット（１０）に接続された画像処理装置、（１４）（１５）は画像処理装置（１３）に接続されたパソコンと画像モニター、（１６）は撮像ユニット（１０）及びパソコン（１４）に接続された照明用電源である。

【００１０】上記構成に基づき本発明の動作（方法）を次に説明する。まず、図２（ａ）に示すように、例えばオイルパンに塗布された線状のシール剤（３）に撮像ユニット（１０）の円環状照明（Ｕａ）（Ｕｂ）によりシール剤（３）の長手方向に向かって左右両側斜め上方から左右対称に照明光を照射し、且つ、撮像ユニット（１０）のＣＣＤカメラ（Ｃａ）で真上からシール剤（３）を撮像する。そうすると、被塗布面上にシール剤（３）の断面厚み形状に対応した陰影が形成され、図２（ｂ）～（ｆ）に示すように、陰影により所定形状の明部と暗部のパターン画像（Ｐｂ）～（Ｐｆ）が生じる。そのパターン画像（Ｐｂ）～（Ｐｆ）はシール剤（３ｂ）～（３ｆ）の平面（幅）及び断面（厚み）形状に応じて変化し、断面形状を反映したものになる。尚、パターン画像（Ｐｂ）（Ｐｃ）（Ｐｄ）及び（Ｐｅ）（Ｐｆ）はそれぞれ照明（Ｕａ）及び（Ｕｂ）によるものである。

【００１１】次に、パターン画像（Ｐｂ）～（Ｐｆ）の左右暗部の最外縁（Ｍｂ）（Ｎｂ）～（Ｍｆ）（Ｎｆ）を輪郭として例えば図３（ａ）に示すシール剤画像（Ｑｂ）を得ると、図３（ｂ）に示すように、図２の輪郭（Ｍｂ）（Ｎｂ）～（Ｍｆ）（Ｎｆ）を一時的に折線（Ｌｂ）に近似化する。そして、画像（Ｑｂ）内における折線（Ｌｂ）の各エッジの座標に基づいて画像（Ｑｂ）内のシール剤を複数のシール剤部分に等分し、上記各エッジの座標から上記各シール剤部分をそれぞれウィンドウ中央に位置させる複数のウィンドウ（Ｗａ）～（Ｗｅ）｛図３（ｃ）を参照｝の中心座標を設定する。

【００１２】例えば、より長い方の輪郭の各エッジ座標（Ｔａ）（Ｔｂ）…を計測して、エッジ間距離を輪郭に沿って計測する。そして、計測したエッジ間距離が設定値を超えた時、例えば（Ｔｂ）～（Ｔｄ）間で設定値を越えて、（Ｔｂ）～（Ｔｄ）間の中間位置（Ａ）が（Ｔｃ）～（Ｔｄ）間にあるとすると、中間位置（Ａ）を通る、直線（Ｔｃ）～（Ｔｄ）の垂線（Ｂ）がシール剤の幅方向の中心と交わる点（Ｚ）をウィンドウの中心としてウィンドウ（Ｗａ）～（Ｗｅ）を設定する。尚、シール剤の幅方向の中心は上記陰影によるパターン画像（Ｐｂ）～（Ｐｆ）の左右暗部の最外縁（Ｍｂ）（Ｎｂ）間～（Ｍｆ）（Ｎｆ）間の幅方向の中間位置である。

【００１３】そして、図３（ｃ）に示すように、各中心座標毎に複数のウィンドウ（Ｗａ）～（Ｗｅ）をその縦方向（Ｘ）の隣接端部をオーバラップさせつつシール剤画像（Ｑｂ）に被せる。そうすると、ウィンドウ（Ｗａ）～（Ｗｅ）内にシール剤画像（Ｑｂ）が全て収まり、しかも各ウィンドウ内のシール剤部分の長さが略均一になる。

【００１４】そこで、図２（ｂ）～（ｆ）に示すように、パターン画像（Ｐｂ）～（Ｐｆ）を２値化処理し、パターン画像（Ｐｂ）～（Ｐｆ）の２値化画像から明部又は暗部の位置、面積及び数をウィンドウ毎に一度に計測する。その計測データは上述のようにシール剤（３）の幅及び断面形状に応じて変化し、断面形状を反映する。例えば照明（Ｕａ）の照射時、図２（ｂ）に示すように、シール剤（３ｂ）断面が円形の場合、シール剤頂部が最も明るくなり、その隣接部が暗くなってパターン画像（Ｐｂ）を得る。又、図２（ｃ）に示すように、シール剤（３ｃ）断面が横長楕円の場合、シール剤頂部の明部が断面円形時より幅広になってパターン画像（Ｐｃ）を得、更に断面偏平になる程、明部が幅広になる。又、図２（ｄ）に示すように、シール剤（３ｄ）上面中央部がやや凹んで二つの頂部が生じた場合、二つの明部が生じてパターン画像（Ｐｄ）を得る。同様に、照明（Ｕｂ）の照射時、円形及び半円の各シール剤（３ｅ）（３ｆ）断面に応じてそれぞれパターン画像（Ｐｅ）（Ｐｆ）を得る。従って、パターン画像（Ｐａ）～（Ｐｆ）よりシール剤断面積を推定出来る。

【００１５】一方、ウインドウ内におけるパターン画像（Ｐｂ）～（Ｐｆ）の輪郭に沿った長さに上記断面積を乗じてシール剤（３）の塗布量（体積）を算出出来る。

【００１６】そこで、予めシール剤断面積に応じて表れる明暗のパターン画像の画像上の特徴量（例えば明部の幅と面積、暗部の幅と面積）とシール剤の断面積との対応関係を求める。例えば上記特徴量を説明変数、シール剤の断面積を目的変数とする重回帰式を予め求めておく。そして、計測された明暗パターン画像の各ウィンドウ毎の特徴量を測定し、上記重回帰式よりシール剤の断面積を演算する。更に、この断面積に画像上のシール剤の長さを乗じて塗布量（体積）を算出する。

【００１７】又は、明暗パターンに応じた断面積と長さと量とを標準データとして作成しておき、計測された明暗のパターン画像と標準パターン画像とをマッチング対比し、ウィンドウ毎にシール剤平面（長さ）及び断面形状（断面積）を推定してシール剤塗布量を検出する。この時、塗布されたシール剤の平面及び断面形状は様々であるが、実質的にはある限定された種類数に限られ、表れる形状の種類は限られるため、用意すべき標準データ数も或る範囲内に収まる。もし、計測された明暗パターン画像に正確に一致する標準データがなければ、最も近い標準データに近似すれば良い。

【００１８】尚、この最も近い標準データの決定にあたっては、ファジィ推論を応用することが出来る。

【００１９】

【発明の効果】本発明によれば、オイルパンの合わせ面等の被塗布面上に塗布されたシール剤の塗布状態を検出するにあたり、シール剤に斜め上方から照明光を左右対称に照射して断面形状を反映した陰影を被塗布面上に形成し、且つ、シール剤を真上から撮像してシール剤画像の輪郭線を一時的に折線近似化し、上記折線のエッジの座標に基づいてシール剤を複数のシール剤部分に等分し、上記エッジの座標からシール剤部分をウィンドウ中央に位置させる複数のウィンドウの中心座標を設定し、シール剤の平面及び断面形状に応じて変化する所定形状の陰影をウィンドウ毎に２値化処理して明部と暗部のパターン画像を形成し、上記パターン画像の特徴量とシール剤の断面積との対応関係を求め、計測されたパターン画像の各ウィンドウ毎の特徴量を測定して上記対応関係によりシール剤の断面積を演算したから、シール剤断面積を推定してシール剤の長さとで塗布量を検出出来、油路詰まり等の発生を防止出来る。又、細かく計測する場合、シール剤が如何なる形状でもシール剤形状に合わせて容易にウィンドウを設定出来、処理時間が短縮される。

【図面の簡単な説明】

【図１】本発明方法を実施する装置の概略側面図。

【図２】（ａ）はシール剤撮像時の断面図。（ｂ）～（ｆ）はシール剤の各断面形状及び明暗パターンを示す図。

【図３】（ａ）はシール剤画像の正面図。（ｂ）は（ａ）の画像を折線近似した正面図。（ｃ）は（ｂ）の折線のエッジ座標からウィンドウ中心を導出する説明図。（ｄ）はウィンドウを被せたシール剤画像の正面図。

【図４】（ａ）はオイルパン合わせ面の正面図。（ｂ）は（ａ）のｂ－ｂ線断面図。（ｃ）は（ａ）のｃ部詳細図。（ｄ）はエクステンションハウジング合わせ面の正面図。（ｅ）は（ｄ）のｅ部詳細図。

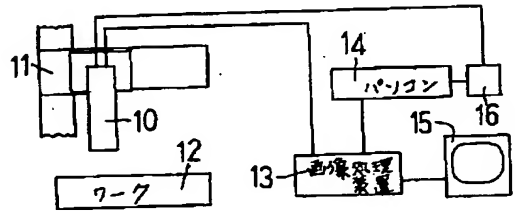
【図５】従来のシール剤の塗布状態検出装置の一例を示す概略側面図。

【図６】（ａ）は図５の装置によって撮像したシール剤画像の正面図。（ｂ）は図６（ａ）のシール剤画像の明度を示すグラフ。

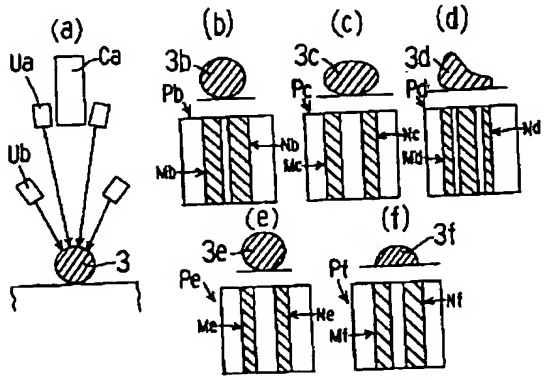
【符号の説明】

３	シール剤
Ｃａ	カメラ
Ｕａ、Ｕｂ	照明
Ｐｂ～Ｐｆ	パターン画像

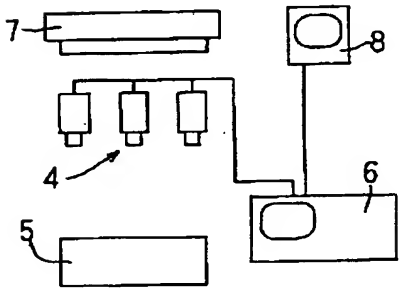
【図１】



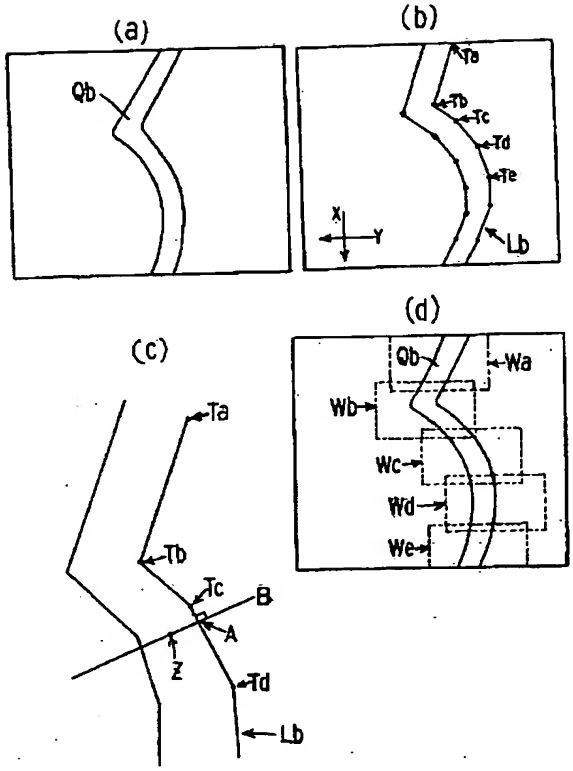
【図２】



【図５】



【図３】


(a)
Qb
(b)
Ta
Tb
Tc
Td
Te
X
Y
Lb
(c)
Ta
Tb
Tc
B
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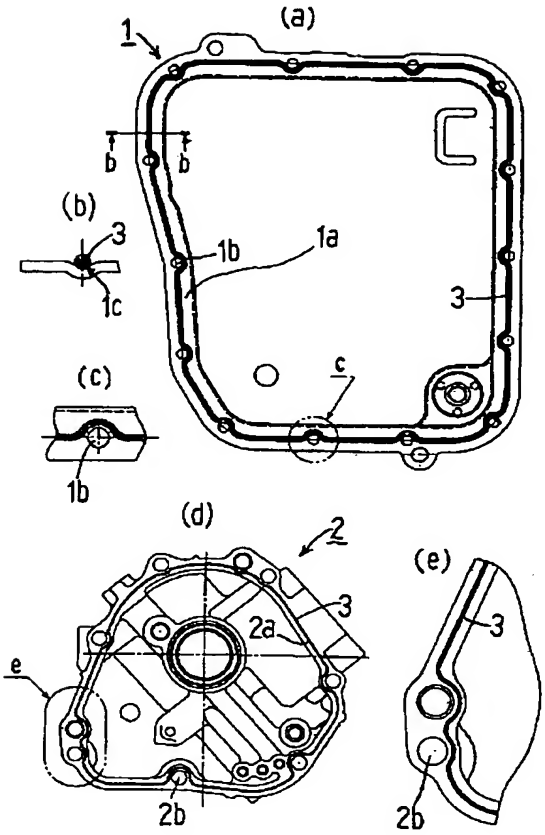
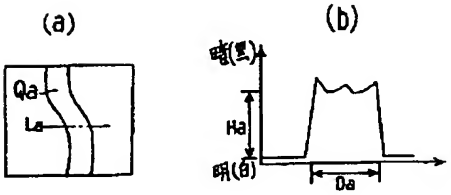
Z
Td
Lb
(d)
Qb
Wa
Wb
Wc
Wd
We

【図４】


1
(a)
b
b
(b)
3
1b
1a
1c
3
(c)
c
1b
(d)
2
3
2a
e
2b
(e)
3
2b

【図６】


(a)
Qa
La
(b)
Ha
Da